Bulletin B.1.1
May 2011

KE2 EvaporatorEfficiency

General Product Information

KE2 Therm Solutions,
Advanced Energy Saving Technology
for Commercial Refrigeration and AC Systems

KE2 Evaporator**Efficiency**
General Product Information

Introduction

The KE2 Evaporator Efficiency (KE2 Evap) is an electronically operated evaporator controller designed to save energy in refrigeration systems. The KE2 Evap controller reduces the energy used by the system through precise control of superheat, fan cycling, reducing compressor run time, and implementing demand defrosts. The KE2 Evap was designed with a quick payback and a life expectancy that matches that of the system. The controller pays for itself, then continues to pay dividends for the life of the system.

KE2 Evaporator Efficiency Energy Savings Through:

The Controller

The KE2 Evap consists of a microprocessor driven controller, sensors, and an optional Electronic Expansion Valve (EEV). The controller's microprocessor provides the ability to control the system with precision and accuracy not available with mechanical controls. The sensors provide the necessary feedback from the system to allow the logic to work. The controller should be combined with an EEV to provide the best control possible.

The controller is provided in kit form, including all of the necessary components – controller, temperature sensors, and accessories. The valve is available separately, as it must be sized to the system capacity. The controller should be mounted on the face of the coil, oriented to use the pre-existing knockouts. Installation Instruction B.7.1 provides sensor mounting instructions.

Operation

The KE2 Evap uses a series of complex algorithms to ensure the evaporator is providing maximum efficiency. The key to its success is minimizing individual component's energy usage in the system. By controlling multiple pieces of the system, the incremental gains of each component are compounded to create substantial savings.

The KE2 Evap has a unique self-learning algorithm. Most controllers use a design that is fixed to a time related event. Because it is adaptable, the KE2 Evap customizes itself to each individual evaporator. The controller does this by first creating a profile of the evaporator's performance characteristics. The performance profile of the evaporator is then continually compared to its current operation. The controller uses this comparison to determine when the system requires defrosting.

Application

KE2 Evap can be used with new or existing applications, is easily configured for use with mechanical or electronic expansion valves, is not refrigerant specific, and can be applied to a wide range of applications. The construction of the controller and its accessories lends itself to easy installation, helping to reduce the total installed cost. When being applied to existing mechanical valve systems, the controller is installed without breaking into the refrigerant circuit.

The KE2 Evap is ideal for applications benefiting from reduction in product shrinkage and tight temperature control. It is Ideal for walk-in coolers and freezers. The KE2 Evap replaces the multiple pieces of a traditional system including: room thermostat, defrost time clock, defrost termination/fan delay thermostat, defrost contactor, etc.

A quick start menu allows the KE2 Evap controller to be taken from the box to operation in a few simple steps. While it is easy to setup, the KE2 Evap also has advanced levels of access. Using the pass code to access the programmer level parameters, the controller can be configured for a variety of applications including direct expansion, commercial and industrial applications.

The algorithm is compatible with systems employing electric, hot gas, and off time defrosts. The reduction of total defrosts and many other operational differences will save energy on any system.

Relays – The controller has 4 relays sized to meet the majority of applications. They are used to control the fans (20A resistive, 10A inductive at 240V), defrost heaters (20A resistive), alarm (5A resistive) and liquid line solenoid or compressor contactor (5A resistive). Systems exceeding the relay ratings should use the onboard relays as pilot to larger relays rated for their specific system requirements.

Evaporator Fans – The evaporator fans are an integral part of the KE2 Evap control. The fans can be configured for KE2 Evap control (precise fan cycling), always on, or traditional operation. The controller defaults to KE2 Evap control to maximize system performance. Compared to the traditional setting, the KE2 Evap setting provides a more consistent space temperature, while saving energy. The KE2 Evap setpoint uses precision fan control to reduce energy usage. The fan control strategy regularly moves the air in the space, in effect stirring the air to prevent stratification, while reducing the rate frost builds on the coil.

Utilizing the information supplied by the sensors, the controller uses the energy created during the refrigerating cycle and stored by the coil. Since the temperature of the coil is reduced

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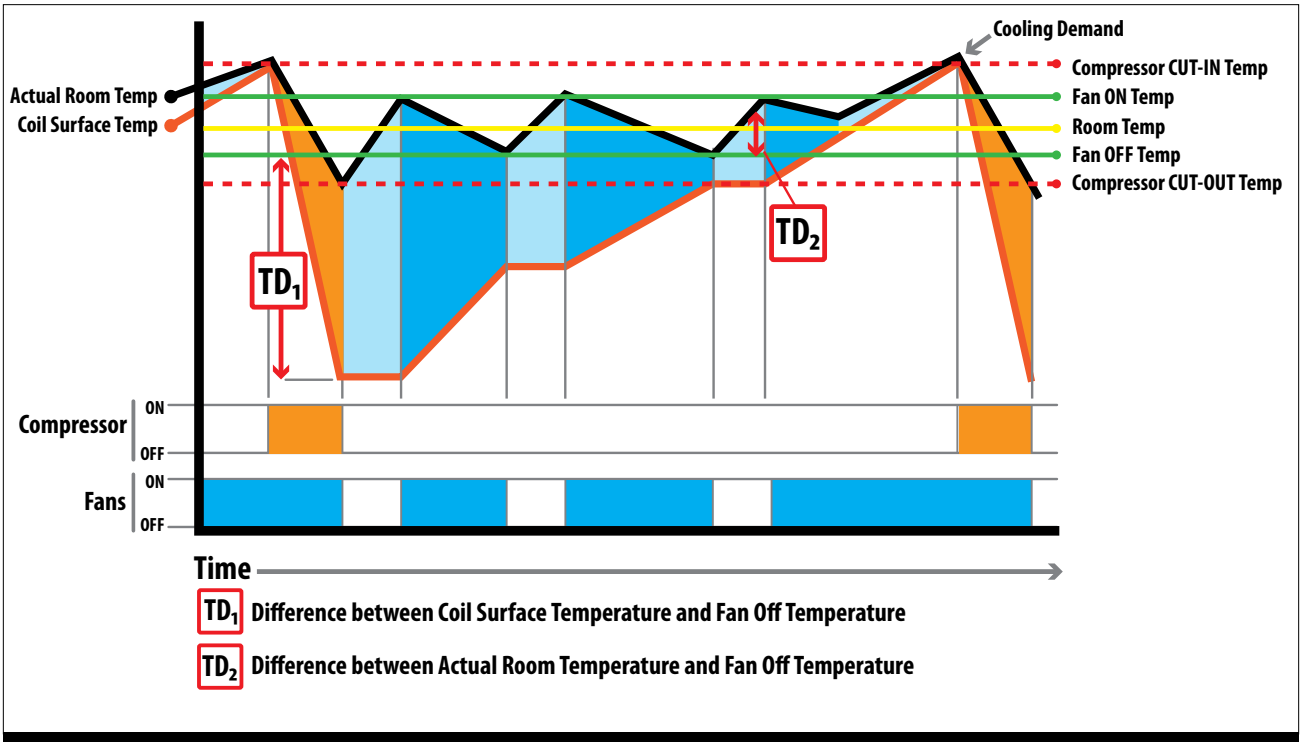
Figure 1 - Principle of Operation



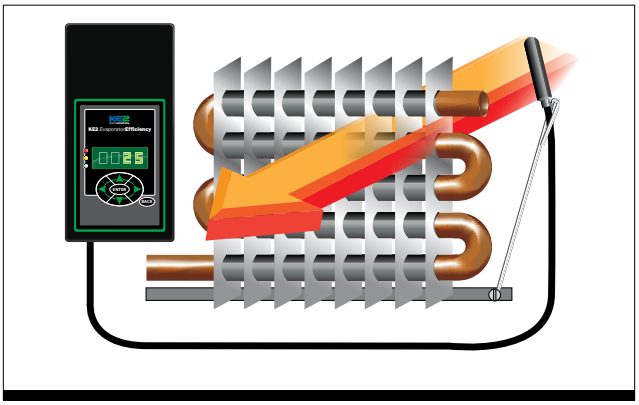
below that of the space temperature, the fans are turned on until the space temperature is satisfied, then turned off. It continues the pattern until the energy stored in the coil is depleted. By continually monitoring the space and coil temperature, the KE2 Evap reduces the frost on the coil. Figure 1 shows how this works in an application.

Defrost Heaters – The KE2 Evap's control of the defrost heaters provides additional savings to the system in two ways. The first, and simplest, way the controller saves heater energy is by reducing the total number of defrosts. When the heaters are not on, energy is not being used to operate the heaters, and the system will not be required to remove the heat added to the space. Although this is passive energy saving, the results have a great impact on energy usage. Energy savings are also created by the defrost control method. This second energy saver is created from the heater's control design. Resistance heaters commonly create a fogging effect due to the high surface temperature of the heaters. To reduce the heater's surface temperature, the controller monitors the coil temperature sensor. When the controller determines the latent energy of the frost has been used up, it cycles the heaters to control the rate the coil approaches the termination temperature. By controlling the heating of the coil KE2 Evap maintains a more even temperature across the coil, eliminating hot spots which cause the fog effect off of the evaporator.

Sensors – The KE2 Evap is supplied with 2 temperature sensors. They provide the space and coil temperatures.

The **space temperature sensor** is supplied with a mounting wire that is attached to the evaporator case in the return air of the coil. This sensor functions to control the space temperature of the room and provides the data used by the controller's algorithm to determine coil performance.

Figure 2 - Space Temperature Sensor



The **coil temperature sensor** provides the input required to determine the current efficiency of the coil and to terminate defrost. It is important that the sensor is located at the coldest point on the coil's surface. This gives the controller the most accurate feedback on the system operating efficiency and helps ensure the coil is completely clear after defrost.

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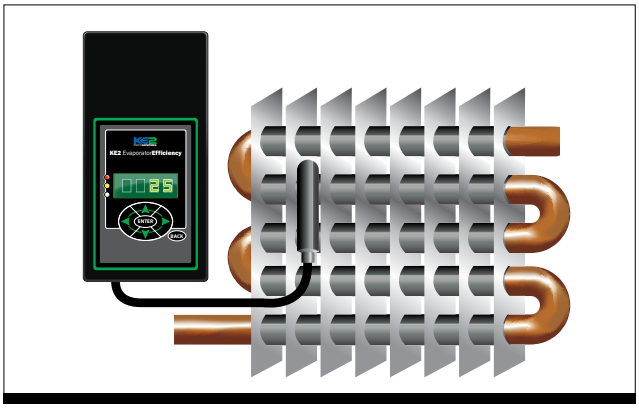
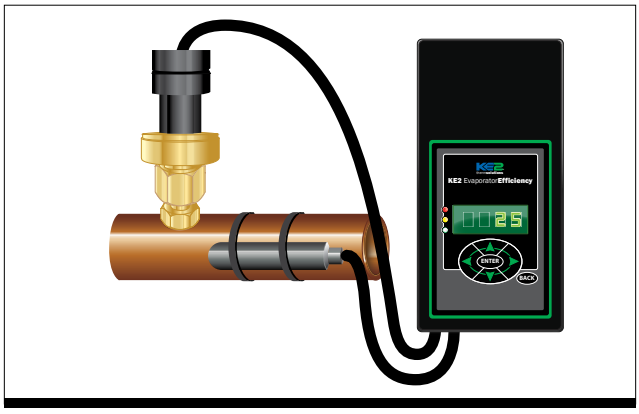
Figure 3 - Coil Temperature Sensor



The **suction temperature sensor** is the input used by the controller to calculate the current superheat of the system. This sensor is essential to ensure maximum use of the evaporator's surface area. Maintaining superheat is critical to the safety of the compressor. By having superheat at the exit of the coil, the compressor is certain to be free from liquid floodback.

A 0-150 psia **pressure transducer** is used for most refrigerants. The exceptions are R-410A and R-744, which use 0-300 psig and 0-500 psig respectively. Transducers are installed on a 1/4" flare connector. A flare connector with Schrader valve is recommended to simplify field service. The transducer attaches to the screw connector and to the sensor with a 3-pin connector. Various cable lengths are available with the sensors.

Figure 4 - Suction Temperature Sensor/Pressure Transducer



Valve – The KE2 Evap was designed for systems utilizing electronic expansions valves (EEV). However, it works equally well on systems utilizing thermostatic expansion valves (TEV). It will provide savings for either type of system. To provide maximum savings, KE2 Therm recommends the use of an EEV. The EEV creates additional savings though the ability to change how the valve is sized. The EEV should be sized to provide adequate flow at a reduced pressure drop. This permits the system to run lower head pressure during the colder months, thus increasing the energy savings.

Communication – The KE2 Evap uses a revolutionary communication system known as the Refrigeration Network. It eliminates the proprietary protocol many companies use to communicate. The KE2 Evap uses Ethernet communication. This type of communication eliminates the need for a serial network and reduces installation cost by eliminating the need for a communication gateway used to translate the serial data to a universal language. The serial communication is replaced by a more robust design that connects controllers utilizing the structure of local area networks.

The immediate benefit to users is the ability to connect to any computer with an internet browser and see the current state of the controller. This removes the burden of downloading software and by sending the information directly to a web browser, the user is no longer required to check for software updates.

Specifications

Controller	
Input Voltage:	120V or 240V
Ambient Temp:	-40° to 140°F
Operating Temp:	-40° to 140°F
Display:	4 digit alphanumeric LED
IP Rating:	IP65
Inputs:	4 temperature sensors (KE2 SKU 20199)
	1 pressure transducer (KE2 SKU 20201)
Valve Types:	unipolar and bipolar stepper motors
Relays:	2 – 20A resistive, 10A inductive
	2 – 3A inductive
Digital Inputs:	door switch (dry contact)
	dual temp setting (dry contact)
Outputs:	0-10V DC
Communication:	Standard TCP/IP
Pressure Transducer	
Pressure Range:	0 to 150 psia
Proof Pressure:	450 psi
Burst Pressure:	1500 psi
Operating Temp:	-40° to 275°F
Temperature Sensor	
Sensor Specs:	-60° to 150°F moisture resistant package

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